usually independent of graphics tools. Viewer programs need to be capable of examining high-bandwidth information streams and large archived scientific databases.

The ability to pre-process massive data sets into useful, storable, retrievable graphics objects will be particularly important as we attempt to scale up to meet the sophistication and detail of the real world. Standardization of computer graphics and portability across other platforms, Brutzman pointed out, is also desirable but historically elusive. Simulation software should be able to take advantage of the Internet and run virtual environments remotely, according to Brutzman. "History has taught us that virtual worlds often outlast the proprietary hardware and software they were designed on." To achieve these goals, the MOVES Institute has been involved in development of several open standards. These include XMSF and X3D.

XMSF

The Extensible Modeling and Simulation Framework (XMSF) is a set of Web-based technologies, applied within an extensible framework, enabling a new generation of modeling and simulation (M&S) applications to emerge, develop and interoperate. Specific subject areas for XMSF include: (a) Web/XML, (b) Internet/networking and (c) modeling and simulation (M&S). XMSF reformation can be found at http://www.movesinstitute.org/xmsf/xmsf.html. XM-based Web services are sufficiently powerful for all types of modeling and simulation.

X3D

Extensible 3D (X3D) is the ISO-approved next-generation open standard for 3-D on the Web. It is an extensible standard that can easily be supported by content creation tools, proprietary browsers and other 3-D applications, both for importing and exporting. X3D not only replaces VRML but also provides compatibility with existing VRML content and browsers. Existing VRML content will be played without modification in any X3D-2 browser, and new X3D-1 and X3D-2 content can be read into existing VRML applications.

X3D addresses the limitations of VRML. It is fully specified, so content will be fully compatible. It is also extensible, which means that X3D can be used to make a small, efficient 3D animation player or to support the latest streaming or rendering extensions. It supports multiple encodings and APIs (application program interfaces), so it can easily be integrated with Web browsers through XML or with other applications. In addition to close ties with XML, X3D is the technology behind MPEG-4's 3-D support. X3D information can be found at www.web3d.org.

Don Brutzman is right. With the proper tools for creating virtual environments, the applications truly are nearly limitless.

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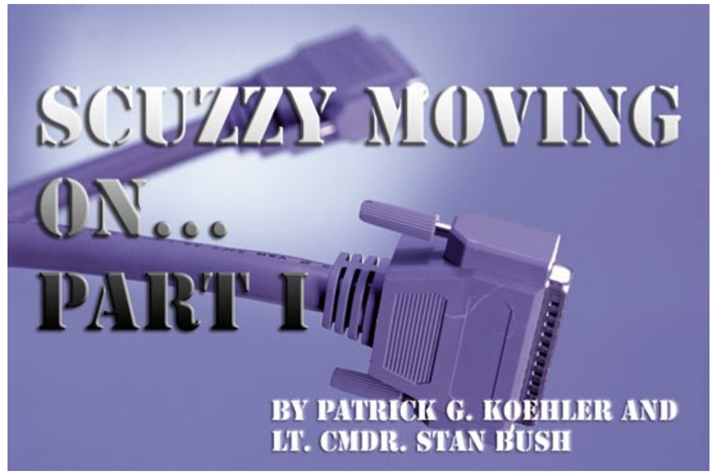

Background

The small computer system interface (SCSI) standard, commonly referred to as "scuzzy," is continually evolving. To keep you informed of the latest SCSI changes, we teamed up to provide a follow-up to a SCSI article which appeared in the *CHIPS Summer 2004* edition (http://www.chips.navy.mil/archives/04_summer/Web_Pages/scuzzy.htm). This article, Part I, of a two part series, will highlight the latest SCSI technologies and standards. For example, there are new devices available such as the Ultra SPI-3 (SCSI-3 Parallel Interface) and SPI-4, and Ultra160 or Ultra320 parallel SCSI devices. The Ultra160 doubles Ultra2 SCSI's speed by as much as 160 MBps for a 16-bit data bus. It is commonly referred to as the Fast-80.

The Ultra160 uses a SPI-3 third generation parallel SCSI interface, which adds five new features: (1) Fast-80 or a data bus speed running at 80 MHz; (2) Cyclic Redundancy Check (CRC) - a common error checking protocol, which is used to ensure data integrity as a safety measure since transfer speeds were being increased, leading to the possibility of data corruption; (3) Domain Validation, which improves the robustness of the process by which different SCSI devices determine an optimal data transfer rate; (4) Quick arbitration and selection (QAS), which represents a change in the way devices determine which device has control of the SCSI bus. (This feature provides a small improvement in performance.); and (5) Packetization - reduces the overhead associated with data transfer.

The Ultra320 uses SPI-4 fourth generation interface for SCSI and has similar features of the SPI-3 except that it again doubles the speed of data transfer to 320 MBps by running the data bus speed at 160 MHz. The Ultra320 is also referred to as Fast-160.

What's New?

Early in 2003, Ultra640 was issued as a standard by the InterNational Committee for Information Technology Standards (INCITS) and called 367-2003 or SPI-5. The SPI-5 is the fifth generation of the SCSI-3 standard. SPI-5 incorporates Fast-320. Ultra640 required a new transfer mode with a 160 MHz free running clock speed to eliminate Inter-Symbol Interface (ISI) problems. Ultra640 uses paced data transfers or packetized SCSI; a free running clock; ISI pre-compensation drivers and active adapter filter receivers; skew compensation; training patterns for the adaptive active filters; and expander communications.

The Ultra640 increases speed to 640 MBps and has similar features as the Ultra320, but offers double the speed. With Ultra640, the support for single-ended interfaces has been downplayed in the SPI-5 interface so future devices may not be backward compatible. This was done to keep SCSI devices running at optimum speed rather than using a single-ended speed of 20 MBps. When you have a mixed SCSI environment on the same connection, the speed will drop to the slowest connection standard so it is a disadvantage to mix narrow with wide SCSI devices. The Ultra640 is new and one of the new adapter products in development is Tekram's DC-390U4 series SCSI adapter. It can achieve a maximum data transfer rate of 640 MBps using a 64-bit adapter even though it is advertised as using an Ultra320 adapter.

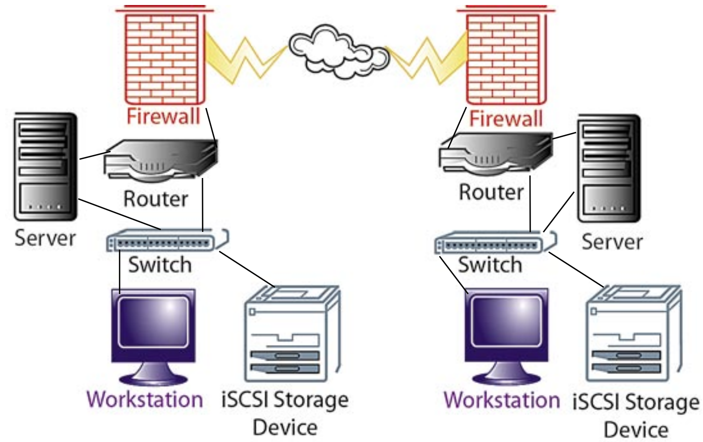

Figure 1. Example of a basic iSCSI network configuration

iSCSI, known as Internet SCSI, embeds SCSI-3 over TCP/IP (Transmission Control Protocol/Internet Protocol); some experts say it may eventually replace Fibre Channel. Fibre Channel is a serial data transfer architecture. The most prominent Fibre Channel standard is Fibre Channel Arbitrated Loop (FC-AL). It is designed for new mass storage devices and other peripheral devices that require very high bandwidth. Using optical fiber to connect devices, FC-AL supports full-duplex data transfer rates of 100MBps.

iSCSI can easily address both the low-end and high-end markets by using Fast or Gigabit Ethernet networks or another network medium to transfer data between SCSI devices. IBM and Hewlett-Packard along with other vendors support iSCSI. This new SCSI standard can promote: storage area network (SAN), network-attached storage (NAS), geographic distribution, data integrity, disk farms, use the existing network cable plant and a single technology for connection of storage systems within local-area networks (LANs) and wide-area networks (WANs). iSCSI will work over a WAN using standard TCP/IP to access iSCSI devices. Data can then be distributed over different networks. iSCSI's lack of built-in security is resolved by using the network security protocols, which will control data using servers, routers, virtual LANs (VLANs) or firewalls. See Figure 1 for an example of a basic iSCSI network design.

What's Next?

Serial Attached SCSI (SAS) or INCITS 376-2003 is another new standard approved by the American National Standards Institute (ANSI) that boasts a greater transmission distance with point-to-point topology using dedicated connections. SAS lowers the operating cost of SCSI with the added benefits of increased cooling, making it easy to connect devices with simplified cable connections. SAS transfer rates start at 1 GBps or 150 MBps. SAS will currently support 3 GB or 300 MBps. The next generation of SAS promises 6 GBps throughput. SAS offers double the speed of the Serial Advanced Technology Attachment (SATA).

SATA is a serial link, a single cable with a minimum of four wires creating a point-to-point connection between devices. Transfer rates for Serial ATA begin at 150 MBps. SATA offers a high data transfer speed with a lower cost than most parallel SCSI devices. SATA devices are becoming popular because of the low cost and the increased cooling capability of the small narrow, serial cable which replaces the flat 40-pin or 80-pin cable. The new SCSI standard of SAS will surpass the performance, flexibility and connectivity of SATA, but SAS and SATA devices are compatible. This compatibility offers benefits to system builders, integrators and end users. System builders can use SAS high performance features to support enterprise networks while SATA can support desktops and LANS. Integrators will have less worry since the interface standards can be interchanged, and end users will get a faster processing speed with SATA.

Where are SCSI devices used?

Parallel SCSI standards of Ultra160, Ultra320 and Ultra640, coupled with SAS will support enterprise networks and disk farms. While iSCSI devices are designed to support network storage at minimal cost using the existing cable plant, SATA-1 and 2 devices are generally used at the desktop level connecting internal hard drives or other peripherals such as optical drives. Universal System Bus (USB) v2.0 and FireWire (IEEE 1394) are external bus standards, which are primarily designed to support desktop external peripherals such as printers, mice, keyboards and external hard drives. Although they are fast and flexible supporting Plug-and-Play and hot plugging, they are comparatively inexpensive. A 1394 port can support isochronous data, delivering data at a guaranteed speed. This makes it perfect for devices that transfer high levels of data in real-time, such as video devices.

For more information go to the Technical Committee T10 (a technical committee of INCITS) Web site at **http://www.t10.org/**.

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